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Vol. III.

Part 4. SIWALIK BIRDS

By R. LYDEKKER, B.A., F.G.S., F.Z.S.,

WITH 2 PLATES (Nos. XIV—XV).

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INDIAN TERTIARY & POST-TERTIARY VERTEBRATA.

SIWALIK BIRDS.

By R. LYDEKKER, B.A., F.G.S., F.Z.S.

(WITH PLATES XIV. AND XV.)

INTRODUCTORY.

Rarity of remains.—In the Siwaliks, as in most ossiferous formations, the remains of birds are extremely few as compared with those of mammals; and such bones as do occur are generally in a fragmentary condition. This rarity is doubtless due to the small size of many birds, and also to the frail structure of the bones themselves,¹ as well as to the circumstance that birds do not become 'mired.' The absence of teeth in ordinary birds is another important element in the case; since our knowledge of many tertiary mammals depends mainly, or entirely, on the evidence afforded by those organs.

Classification.—Considerable difficulty is found in regard to the classification of fossil birds, since the characters on which the recent orders are usually founded are to a great extent external, or are of such a nature as to be inapplicable to fossils, and the different orders do not consequently present the well-marked osteological differences of the Mammalia. Here again the want of the strong diagnostic characters afforded by the teeth of the latter is very strongly felt. In consequence of these wants it is frequently extremely difficult, or impossible, to say whether fossil birds belong to new orders or to those still existing; and it may perhaps be doubted whether it will be found ultimately advisable to retain for paleontological purposes many of the orders into which existing birds are divided. For the present, as a provisional arrangement, the writer has in the main adopted the classification given by Mr. Selater in the "List of the Animals in the Gardens of the Zoological Society": the terms Carinata and Ratite, which are extremely convenient for

¹ This does not apply to the struthious birds

² 8th ed., London, 1883.

paleontological purposes, have, however, been added as divisions of the value of a sub-class: and the orders of the struthious birds have been suppressed as being paleontologically inapplicable. The generic terms adopted by Mr. Selater have been invariably employed in the present memoir.

Literature.—The literature relating to Siwalik birds is comparatively small. A brief allusion to the occurrence of birds in the Siwaliks is made in Falconer's notes,¹ and another occurs in a small pamphlet by the late Gen. Sir W. E. Baker.² Most of the remains collected by Falconer and Cautley are figured in unpublished plate R. of the "F.A.S.," but are not named in the description given in the "Paleontological Memoirs."³ Several of these bones were subsequently named by M. Alphonse Milne-Edwards⁴; and a note on these and other remains was published in 1879 by the present writer.⁵ A more important memoir by Mr. W. Davies,⁶ of the British Museum, with a plate of illustrations, appeared in the following year.

In the present memoir all the remains of Siwalik birds which appear to admit of determination are more or less fully described; while those specimens which have been hitherto known merely by preliminary notices have been figured. Some of the more important figures from the "F.A.S." and Mr. Davies' memoir have been reproduced. There are a few broken specimens of Siwalik bird-bones in the British Museum whose affinities it has not yet been found possible to determine.

SUB-CLASS I.: CARINATÆ.

ORDER: STEGANOPODES.

FAMILY: PELECANIDÆ.

GENUS: PELECANUS, Linn.

Distribution.—The genus has now a world-wide distribution, and is represented by a large number of species.⁷ It is represented in the miocene of Europe by *P. intermedius*, Fraas,⁸ and *P. gracilis*, Milne-Edwards,⁹ of Allier; both of which seem to be closely allied.¹⁰ The so-called *P. miocanus*, Lartet, is considered by Milne-Edwards to be nearer *Sula*.¹¹ It is possible that *Pelecanus* was represented in the eocene of Paris.¹²

¹ "Paleontological Memoirs," vol. 1, p. 23.

² "Memoir on the Fossil Remains presented by himself and Col. Colvin to the Museum at Ludlow," p. 16 (Ludlow, 1850).

³ Vol. 1, p. 564.

⁴ "Recherches Anatomiques et Paléontologiques pour servir à l'histoire des Oiseaux Fossiles du la France." (Paris, 1867-77.)

⁵ "Notes on some Siwalik Birds." "Records," vol. X.I, p. 52.

⁶ "On some fossil Bird Remains from the Siwalik Hills in the British Museum." "Geol. Mag.," decade 2, vol. VII., p. 18, pl. 11 (1880).

⁷ A list is given by A. Dubois, "Bul. Mus. Roy. Hist. Nat. Belg.," vol. II., p. 1 (1882).

⁸ "Fauna von Stenheim," pl. X, fig. 3 (skull).

⁹ *Op. cit.*, vol. I, p. 250, pls. XXXVIII-IX.

¹⁰ *Ibid.*, vol. II., p. 576.

¹¹ *Ibid.*, vol. I., p. 250.

¹² *Ibid.*, vol. I., p. 249.

Species 1: PELECANUS CAUTLEYI, Davies.

History.—This species was founded by Mr. Davies in the memoir already quoted.¹

Ulna.—The specimen on which this species is founded consists of the distal extremity of a left ulna, from the Siwaliks, in the British Museum, which is represented in pl. XIV., figs. 11, 11a. It is somewhat smaller than the ulna of the existing Indian and African *P. mitratus*; but agrees in the form of the trochlear articulation (*a*), and of the external tendinal pit and adjacent process (*b*). It differs, however, in the greater depth and elongation of the palmar trochlear depression (*c*), as well as in the more laterally compressed form of the shaft. In the size of the depression (*c*) it differs from all the species with which it has been compared. Its dimensions are compared below with those of *P. mitratus*, viz.:—

		<i>P. cautleyi</i> .	<i>P. mitratus</i> .
Transverse diameter, including radial tuberosity		0.7	0.86
Ant.-post. „ of ulna trochlear		0.75	0.95
Transverse „ „ shaft		0.45	0.58
Ant.-post. „ „ „		0.6	0.65

It is impossible to compare the Siwalik bone with *P. gracilis*, as the ulna of that species is not figured; but it is decidedly different from the ulna of *P. intermedius* (B. M., No. 48,164), although of very nearly the same dimensions.

Distinctness.—Although the comparisons that have been made indicate the distinctness of this Siwalik pelican from several species, yet the possibility of its identity with some of the existing species of which skeletons are not available must be borne in mind, and the name *P. cautleyi* must, therefore, be regarded as provisional.

PELECANUS SIVALENSIS, Davies.

History.—This species is named on page 26 of Mr. Davies' memoir.

Ulna.—This species also is founded on the distal extremity of an ulna from the Siwaliks in the British Museum (No. 39,745), which has not been figured. It differs from the corresponding bone of *P. cautleyi* by its inferior size, the shallowness and shortness of the palmar trochlear depression, and other minor points. It is of inferior size to the ulna of *P. mitratus* and *P. intermedius*, but agrees so closely in general characters that there seems no doubt of its belonging to the same genus. The dimensions of the specimen are as follows, viz.:—

Maximum transverse diameter	0.52	Transverse diameter of shaft	0.4
Ant.-post. diameter of ulna trochlear	0.6	Ant.-post. „ „ „	0.5

Distinctness.—There can be no question as to the distinctness of the present form from *P. cautleyi*; and the difference in size probably indicates specific distinctness from *P. mitratus* and *P. intermedius*. The specimen has not, however, been compared with *P. gracilis*, nor with most of the existing species, and its right to a distinct specific name must accordingly be regarded as provisional.

FAMILY: *PHALACROCORACIDÆ*.GENUS. *PHALACROCORAX*, Briss.Syn. *Graculus*, Linn.

Distribution.—At the present day the genus has an almost world-wide distribution, and is represented by a large number of species. A coracoid in the British Museum from the pleistocene of Grays, Essex, indicates a species closely allied to, if not identical with *P. carbo*¹; and a tarso-metatarsus in the same collection has been obtained from the prehistoric deposits of New Zealand.² *P. macropus* (Cope),³ has been recorded from the pliocene of North America; and the tertiaries of the same country have also yielded *P. ulahensis* (Marsh). From the French miocene three species have been determined⁴ under the names of *P. miocenensis*, *P. littoralis*, and *P. intermedius*.

PHALACROCORAX, sp.Syn. *Phacton*? sp., Milne-Edwards; *Graculus*, sp., Davies.

History.—The proximal extremity of a small tarso-metatarsus⁵ in the Cautley collection of the British Museum was considered by M. A. Milne-Edwards⁶ to have possibly belonged to a species allied to the existing tropic-bird. The present writer⁷ suggested that this provisional reference was an improbable one, and it was subsequently shown by Mr. Davies⁸ that the specimen probably belonged to *Phalacrocorax* (*Graculus*), or a closely allied genus.

Metatarsus.—The above-mentioned specimen, which was obtained from the Siwalik Hills, is represented in plate XIV., figs. 10, 10a. It agrees with the corresponding bone of *P. carbo* in the form of the concave facets and tuberosity of the superior surface, in the depth of the median groove on the anterior surface, in the form of the tendinal canal on the same surface, and of the calcaneal process and grooves. It differs in having the anterior surface of the outer metatarsal less sharply ridged, and that of the inner less depressed below the articular cavity; as well as in the deeper depression on either side of the calcaneal process. It is almost indistinguishable from the above-mentioned bone from New Zealand.

Distinctness.—Other comparisons have not been made, and it is therefore uncertain whether the Siwalik cormorant is or is not identical with any of the other named species.

ORDER. *HERODIONES*.FAMILY: *CICONIIDÆ*.GENUS: *LEPTOPTILUS*, Lesson.Syn. *Argala*, Hodgson; *Osterophea*, Hodgson.

Distribution.—This genus is confined at the present time to W. Africa (where it

¹ A. Milne-Edwards, *op. cit.*, vol. I., p. 277.² Davies, *op. cit.*, p. 9.³ *Op. cit.*, vol. I., p. 260.⁴ This bone will in the sequel be simply termed the metatarsus.⁵ *Op. cit.*, p. 57.⁶ 'Bull. U. S. Geol. Survey,' vol. IV., p. 386.⁷ A. Milne-Edwards, *op. cit.*, vol. I., p. 265, *et seq.*⁸ Similarly the tarso-tarsus will be termed tibia.⁹ *Op. cit.*, pp. 6-9.

is represented by *I. crumeniferus* [Cuv.] and the Indo-Malayan region (where it is represented by *I. argala* [Linn.], of India and Burma, and *I. javanicus* [Horsf.], of Java). From the Pikermi beds a humerus has been figured by Prof. Gaudry as *Ciconia* (?), which may possibly belong to the present genus¹; and a species of the genus from the miocene of France has been named *Leptoptilus arvernensis* (Milne-Edwards²).

Species: *LEPTOPTILUS FALCONERI* (A. M.-Edw.)

Syn. *Argala falconeri*, A. M.-Edw.

History.—In the Introduction to the "F.A.S.," compiled in the "Palaeontological Memoirs,"³ it is stated that "among the Siwalik fossils there are also the remains of several species of birds, including *Ciconia*, greatly surpassing in size the gigantic crane [*sic.*] of Bengal (*Ciconia* [*Leptoptilus*] *argala*)."⁴ Subsequently M. A. Milne-Edwards,⁵ who had some doubts whether the specimens might not indicate two species, described the proximal and distal extremities of the metatarsus, and two specimens of the distal extremity of the tibia of a large Siwalik stork in the collection of the British Museum under the name of *Argala falconeri*. At a later date the present writer⁶ briefly recorded the discovery by Mr. Theobald in the Siwaliks of the Punjab of a cervical vertebra, the distal extremity of a tibia, and the first phalangeal of the outer digit of the foot of a large stork, which were provisionally referred to the same species.⁶ Mr. Davies⁷ afterwards described under the same name three other Siwalik specimens in the British Museum; *viz.*, a part of the first phalangeal of the wing, and the distal extremities of the femur and the humerus. A figure of the latter specimen is given in the plate in Mr. Davies' memoir; while the other two specimens mentioned by him, as well as those on which the species was founded, are figured, although unnamed, in unpublished plate II. of the "F.A.S."

Tibia.—The specimen which it may be convenient to take as the type of the species is the distal extremity of a right tibia in the British Museum (No. 39,735), figured in the "F.A.S.," pl. R., figs. 3, 3a, 3b, 3c. This specimen is rather larger than the tibia of an old *I. argala*, but presents no other points of distinction. The second specimen (B.M., No. 39,734) is also the distal extremity of the right side, but comprises rather more of the shaft: it is represented in figs. 5, 5a, 5b, 5c of the same plate, and is considerably smaller than the first specimen. The third specimen was obtained by Mr. Theobald from the Siwaliks of the Punjab, and is represented in plate XIV., figs. 9, 9a, 9b. It is the distal extremity of the right side, and is considerably smaller than the second specimen, and slightly smaller than the corresponding bone of a skeleton of *I. crumeniferus* in the Museum of the Royal College of Surgeons. It presents no distinctive characters from the latter bone,

¹ "Animaux Fossiles et Géologie de l'Attique," p. 315, pl. LIX, fig. 12

² *Op. cit.*, vol. II, p. 572 (1871). The species is undescribed in that work.

³ Vol. I, p. 23 (1865).

⁴ *Op. cit.*, vol. I, p. 449 (1869-71)

⁵ "Records," vol. XIII, p. 66 (1870)

⁶ The vertebra is now referred to another form.

⁷ *Op. cit.*, p. 6

which seems to be distinguished from that of *L. argala* merely by its inferior size. The dimensions of the three Siwalik specimens are as follows:—

Antero-posterior diameter of inferior surface . . .	1 32	1 2	0 93
Transverse ditto . . .	1 05	0 93	0 71

There is a fourth imperfect specimen in the British Museum (No. 48,444) agreeing very closely with No. 39,734.

Metatarsus.—The distal extremity of the left metatarsus is represented in plate R, figs. 14, 14a, 14b, of the "F.A.S.," and in plate XIV., fig. 14 of this volume; and is in the British Museum. It is considerably larger than the corresponding bone of a large *L. argala* (the respective transverse diameters being 1·36 and 1·25), but presents no difference in form. The proximal extremity of a right metatarsus is represented in figs. 9, 9a of the same plate¹ of the "F.A.S." (B.M., No. 39,741); which is smaller than the corresponding bone of a full-sized *L. argala*.

Pedal phalangeal.—The bone represented in plate XIV., fig. 12, was obtained by Mr. Theobald from the Siwaliks of the Punjab: it is the first phalangeal of the outer (fourth) digit of the right foot; and is practically indistinguishable from the corresponding bone of *L. crumeniferus*, and agrees therefore in size with the smallest tibia.

Femur.—The distal extremity of the left femur is represented in plate R., figs. 4, 4a, 4b of the "F.A.S." (B.M., No. 39,737). This specimen is indistinguishable in form from the femur of *L. argala*, but is of rather larger size than a large specimen of that species; the respective transverse diameters of the two bones being 1·77 and 1·48.

Humerus.—The distal extremity of the left humerus is represented in pl. XIV., fig. 1, and is likewise in the British Museum: it is indistinguishable from the humerus of *L. argala*, except in its slightly superior size; the respective dimensions being as follows:—

	<i>L. falconeri</i> .	<i>L. argala</i> .
Transverse diameter at condylar tuberosities . . .	2·3	2·1
" " of condyles . . .	1 75	1 5

Phalangeal of the manus.—The proximal third of the first phalangeal of the wing is in the Cautley collection of the British Museum (No. 39,738), and is represented in plate R., figs. 8, 8a, 8b, 8c, of the "F.A.S." It differs from *L. argala* merely by its slightly superior size, and by the circumstance that the lateral lamelliform expansion rises rather more abruptly.

Distinctness and affinities.—The foregoing specimens indicate the existence of one or more species of stork in the Siwaliks, some individuals of which were of considerably larger size than the largest specimens of *L. argala*, while others were not larger than *L. crumeniferus*. As there is a considerable amount of variation in the size of the former species, and as there appears to be no distinctive structural differences between the limb-bones of the fossil form and of the three living species, it seems impossible to say whether the former includes more than one species; and equally

¹ The figures show the posterior and superior aspects

impossible to say whether the fossil form, or forms, be not respectively identical with one or more of the living species. In view of the impossibility of distinguishing several of the Siwalik reptiles from existing species, it is not improbable that there may be a similar specific identity between some of the birds of the two epochs; but our knowledge of the rate of specific evolution in the latter class is at present so imperfect that nothing can be advanced with any confidence. The writer has not seen a description of *L. arvensis*; which name is, however, of later date than *L. fulconeri*. Under these circumstances the name *Leptoptilus fulconeri* must be regarded as a purely provisional one. The above-mentioned humerus from Pikerim indicates a bird considerably smaller than *L. argala*.

Distribution.—Remains of the present form have been obtained from the typical Siwalik Hills, and the Punjab.

GENUS, *non. det.*

History.—The specimen forming the subject of the present notice was previously referred to *Leptoptilus fulconeri*.¹

Cervical vertebra.—In plate XIV., figs. 7, 7a, 7b, 7c, 7d, there are given five views of the cervical vertebra of a large bird collected by Mr. Theobald from the Siwaliks of Asnot, Punjab. The specimen is a fourth cervical; so determined from the large size and shortness of the neural spine (*ns.*, fig. 7c), and the shortness of the lateral carotid canal² (*cc.*, fig. 7). The summit of the neural spine and the processes surrounding the carotid canals have been broken away. The bone, although rather larger, has such a general agreement in structure with the corresponding vertebra of *Leptoptilus argala*, that it may be pretty safely referred either to the *Ciconiidae* or the allied *Ardeidae*.

Compared with the fourth cervical of *Leptoptilus argala* the specimen differs by being shorter and higher; by the more distinct hollow (*x*, fig. 7c) between the prezygapophyses (*prz.*); by the larger size of the neural spine (*ns.*), which extends backwards over the postzygapophyses (*ptz.*); by the closer approximation of the two latter; and by the absence of distinct surfaces for muscular attachment above the same. In its greater vertical height and longer neural spine the vertebra of *L. crumeniferus* comes nearer to the fossil; but is distinguished by the other characters of that of *L. argala*. In both the existing species the prezygapophyses (*prz.*) are separated by a distinct notch, extending as far backwards as their posterior border.

The fossil bone, although much larger, agrees more nearly in proportions with the fourth cervical of *Baleniceps* and *Mycleria*, but is distinguished by the neural spine extending farther backwards, and being higher posteriorly, as well as by the more distinct hollow (*x*) between the prezygapophyses. It is on the whole nearer to *Mycleria* than *Baleniceps*. Compared with the fourth cervical of *Canceroma* (*Ardeidae*) the Siwalik bone is of very much larger size, but agrees in its relatively large height,

¹ 'Records,' vol. XII, p. 66.

² Two carotids are present in the *Ciconiidae* and most of the *Ardeidae*, vide Harrod, 'Proc. Zool. Soc.', 1873, p. 467.

and in the form of the neural spine; although differing by its shorter centrum, and the other characters in which it differs from *Leptoptilus*. The writer has not found any other birds whose vertebra approaches so nearly to the fossil as those mentioned above; and all the other genera have vertebra very much smaller than the specimen under consideration.

Distinctness and affinities.—The foregoing comparisons show that the present specimen probably indicates a Siwalik stork (or allied form) exceeding in size the largest *Leptoptilus argala*, and specifically distinct from any living bird. The circumstance that the limb-bones of *L. falconeri* are practically indistinguishable from those of *L. argala* renders it almost certain that the present vertebra does not belong to the former. Whether the characters pointed out as distinguishing the fossil vertebra from the existing genera with which comparisons have been made should be regarded as of generic or of specific value appears extremely doubtful; and it, therefore, seems advisable not to attempt to give any name to the present huge Siwalik bird. The distribution and relations of the genera *Leptoptilus*, *Mycteria*, and *Icthyophaga* are such as to render it highly probable that an allied extinct genus should have formerly existed in India.

ORDER: ANSERES.

FAMILY: ANATIDÆ.

GENUS: MERGUS, Linn.

Distribution.—The genus has a wide distribution, being found in the Palearctic, Neartic, and Neotropical regions. It has apparently been hitherto unknown in the fossil state.¹

MERGUS (?) sp.

History.—The specimen on which this determination rests is noticed here for the first time.

Cervical vertebra.—In plate XIV., figs. 3, 3a, 3b, there are given three views of an early cervical vertebra of a bird obtained by Mr. Theobald from the Siwaliks of Asnot, Punjab. Fig. 3 represents the haunal, fig. 3a the anterior, and fig. 3b the neural aspect. The specimen has lost both pairs of zygapophyses, a portion of the neural spine, and the posterior part of the lateral expansions of the centrum.

This vertebra is characterized by the extreme flatness and width of its haunal surface (fig. 3); and in this respect comes nearer to *Mergus* than to any other genus with which the writer has been able to compare it. It is still shorter and wider than the corresponding vertebra of *M. serrator*, but indicates a bird of about the same size. The writer has been unable to compare the specimen with *M. merganser*, *M. albellus*, or *M. castor*.

Although the generic determination cannot be considered as certain, the present

¹ The so-called *Mergus ransonii*—*Sula ransonii*.

specimen may be taken to indicate in all probability the occurrence in the Siwaliks of a bird closely allied to, if not identical with, *Meryus*.

GENUS, *non. det.*

Phalangeal of the foot.—In plate XIV., fig. 13, there is represented a bone obtained by Mr. Theobald from the Siwaliks of the Punjab, which is apparently the first phalangeal of the median (third) digit of the foot of some stout-limbed swimming or walking bird; the proximal extremity is somewhat worn, and the whole of the external surface is partially decayed. The specimen is very similar to the corresponding bone of the Australian *Cercopsis*, but it is insufficient to determine even the order to which its owner belonged.

SUB-CLASS II.: RATITÆ.

FAMILY: STRUTHIONIDÆ.

GENUS: STRUTHIO, Linn.

Number of species.—At the present day the genus is represented by the well-known *S. camelus*.¹ An ostrich has indeed been recently described from Somali Land under the name of *S. molybdophanes*, Reichenow,² but there is considerable doubt as to its claim to specific distinction; and, in any case, it is distinguished at present merely by external characters, so that for palæontological purposes it may be grouped with *S. camelus*. The species described below is the only fossil representative.

Species: STRUTHIO ASIATICUS, A. M. Edwards.

Syn. *S. palæindicus*, Falc., MSS.; *Megaloscelornis sivalensis*, nobis (in part).

History.—Apparently the first mention of a Siwalik ostrich is in a letter from Falconer to De Blainville, dated October 4th, 1847, in which certain remains were alluded to under the name of *S. palæindicus*.³ In 1871 (or a little earlier) M. A. Milne-Edwards⁴ proposed the name of *S. asiaticus* for the Siwalik species; and in 1880 Mr. Davies⁵ described the remains on the evidence of which this name had been assigned, giving a figure of the most important specimen. It was mentioned at the same time that other remains had been figured in unpublished plate R. of the "F.A.S.," but had received no name. In the previous year the present writer⁶ briefly described two bones from the Siwaliks (which had been found in juxtaposition and were labelled by Falconer as remarkable specimens) and referred them both to a bird, to which he applied the new generic and specific name of *Megaloscelornis sivalensis*. One of these bones, which was regarded as the sternum of this new bird, turns out to be a portion of the carapace and plastron of an emydid chelonian, which presents a most extraordinary resemblance to an avian sternum.⁷ The other bone is a portion

¹ *S. australis*, Gurney, seems to be merely a variety.

² 'Sountage-Dolgo zur Norddeutschen Allgemeinen Zeitung,' September, 1883.

³ 'Fide' This, 1884, pp. 116, 362.

⁴ 'Fide' 'Pal. Mem.," vol. I., p. xxi. (1868).

⁵ *Op. cit.*, vol. II., p. 587.

⁶ *Op. cit.*, p. 19.

⁷ 'Records,' vol. XII., p. 55.

⁸ The writer is indebted to Prof. A. Newton, of Cambridge, for this correction.

of a tibia and belongs to the present species.¹ The genus *Megaloscelornis* must, therefore, be abolished.²

Metatarsus and phalangeal.—In plate XV., fig. 3, there is given a full-sized view of the distal half of the right metatarsus, with the proximal half of the first phalangeal of the inner digit; obtained from the Siwalik Hills. These bones are indistinguishable, both as regards form and size, from those of the existing ostrich.

Tibia and fibula.—In plate XV., figs. 2, 2a, there are two half-sized views of the distal half of a right tibia from the Siwalik Hills.³ The articular portion of the bone is somewhat damaged; but allowing for this loss the specimen is indistinguishable in all respects from the tibia of *S. camelus*. In figures 1, 1a of the same plate there are two similarly reduced views of the greater portion of a right tibia and fibula⁴ from the Siwalik Hills. The specimen is imperfect superiorly, the fibula (/) being broken off lower down than the tibia: a transverse section of the specimen at a fracture shows that the tibia and fibula are perfectly distinct, although cemented together by matrix. Distally the specimen has lost its articular extremity (astragalus); thus showing that it belonged to an adolescent individual. This specimen agrees precisely in every respect with the last, and with the corresponding bone of *S. camelus*.

Bones of the wing.—The metatarsus described above is associated with some of the wing-bones and some cervical vertebrae, doubtless belonging to the same individual. The wing-bones comprise the distal ends of the radius and ulna, the metacarpus, and a phalangeal; and the only difference than can be detected between these bones and those of *S. camelus* is that the metacarpals are slightly stouter.

Vertebrae.—The above-mentioned cervical vertebrae are twelve in number, five of which are figured in plate II., figs. 1, 1a of the "F.A.S.": they are fully described by Mr. Davies. The vertebrae resemble those of *S. camelus* in general size; but their larger anterior transverse diameter and greater vertical depth seem to indicate that the Siwalik ostrich had a stouter neck.

Distinctness and affinities.—The foregoing comparisons show that the Siwalik ostrich was extremely close to the existing species; and it seems doubtful whether the slight differences in their cervical vertebrae can be regarded as of more than individual, or varietal, value. Under these circumstances the name *S. asiaticus* must be regarded as provisional.

Distribution.—All the known remains have been obtained from the typical Siwalik Hills: it is, however, to be expected that the species will eventually be found

¹ The tibia was referred to *Megaloscelornis* from the circumstance that it was associated with the supposed sternum. This example affords a warning against relying on the association of Siwalik bones as indicating individual identity. It seems from the labelling of the specimens that this association deceived Falconer. The writer considered that the tibia differed from that of struthionids by the ankylosis of the fibula, but a subsequently made section of the specimen has shown that the two bones are really distinct.

² A portion of a humerus from Sind noticed in the 'Records,' vol. XVI, p. 68, which it was suggested might possibly belong to *Megaloscelornis*, seems to be probably eocretan.

³ Figured in the "F.A.S.," pl. II., figs. 2, 2a, 2b, 2c, 2d.

⁴ This specimen is the one originally referred to *Megaloscelornis*.

in the Siwaliks of the Punjab, since it is pretty evident that the genus must once have ranged through Persia, and have thus connected its present habitat (Syria, and Africa) with its old Indian home.

FAMILY: *CASUARIDÆ*.

GENUS: *DROMÆUS*, Vieill.

Number of species.—There is apparently only a single well-established existing one!—*D. nove-hollandiæ*, Vieill.; and the form described below is the only fossil that has been referred to the genus.

Species: *DROMÆUS* (?) *SIVALENSIS*, *nobis*.

History.—This species was named by the writer² in 1879 on the evidence of four phalangeal bones collected by Mr. Theobald in the Siwaliks of the Punjab, which form the subject of the present notice.

Phalangeals.—Of the first specimen three views are given in plate XIV, figs. 2, 2a, 2b. This bone is the first phalangeal of the outer (fourth) digit of the right foot of a tridaactyle struthioid; and is in fair preservation, but has lost a small portion of the inner border of the proximal extremity (fig. 2b). In figure 6 of the same plate there is represented the corresponding bone of the opposite foot of a slightly smaller struthioid. This specimen has been considerably rolled; and its distal extremity, as well as the anterior aspect of the proximal extremity, are consequently imperfect. In general contour this bone is very similar to the last; but has the inner extremity of the proximal surface (*a*) somewhat more produced. It is somewhat doubtful whether these differences in size and form should be regarded as of individual or specific value; but it seems advisable in the absence of other evidence to regard them provisionally in the former light. These bones are very near indeed to the corresponding bone of *Promæus nove-hollandiæ*; being mainly distinguished by the slighter development of the pit on the inner aspect of the distal extremity, and their considerably larger size. They do not come so close to the corresponding bone of any other struthioid.

In figure 5 of the same plate there is represented the second phalangeal of the outer digit of the left foot of a tridaactyle struthioid, agreeing in relative size with the larger first phalangeal (fig. 2). This bone is only distinguished from the corresponding phalangeal of the living emeu by its superior size and the somewhat greater expansion laterally and inferiorly of the outer articular trochlea (*a*). Both the recent and fossil bones are characterized by the presence of a pit on the outer side only of the distal extremity. There is every probability that the fossil belongs to the same species as the first phalangeal represented in fig. 2.

In figs. 4, 4a, 4b of the same plate there are given three views of a larger second phalangeal of the same digit and foot, which corresponds so exactly in form with the smaller specimen that it evidently belonged to the same kind of bird.

¹ *D. traversata*, Bartl, is generally regarded as a variety

² 'Records,' vol. XI, pp. 53-4

In the following table the dimensions of the four specimens described above are compared with those of the corresponding bones of the living emeu. The two middle-sized fossil bones, which belonged to individuals of the same size, are placed in the second column:—

	Fossil.		D. nova-hollandiae
	24	23	
Length of first phalangeal	1.36	1.15	1.8
Ant.-post. diam. of proximal surface of ditto	1.3	1.2	0.75
Transverse ditto ditto	0.9	0.7	0.7
Ant.-post. diam. of distal ditto	1.0	0.8	0.16
Transverse ditto ditto	1.51	1.3	0.6
Length of second phalangeal	1.0	0.85	0.8
Ant.-post. diam. of proximal surface of ditto	1.38	1.1	0.66
Transverse ditto ditto	0.7	0.65	0.62
Ant.-post. diam. of distal ditto	1.35	1.08	0.45
Transverse ditto ditto			0.51

Distinctness and affinities.—The resemblance of the bones described above to those of the living emeu is so close that there seems little doubt but that they indicate the existence of a nearly allied bird in the Siwaliks. Whether the fossil was generically identical with the recent form may perhaps on the whole be somewhat doubtful, but there is every probability that the one was the ancestral form of the other; and it may therefore be well to continue to refer the fossil to *Dromæus*, until such time as it shall be proved distinct. It is, however, by no means improbable that the Siwalik bird may belong to the pleistocene Australian genus *Dromornis*, of which the corresponding bones are at present unknown. That the Siwalik form was specifically distinct from the living emeu is evident, and the specific name *siwalensis* may therefore stand. Whether more than one species is at present comprehended under that name cannot be determined; but if such should eventually prove to be the case, the middle-sized bones whose measurements are given in the second column of the foregoing table may be regarded as the types.

Distribution.—As previously observed, the present form has hitherto been obtained only from the Siwaliks of the Punjab; but from its relationship to the Australian emeu it is to be expected that it will eventually be found in the typical Siwalik Hills.

The former occurrence in India of a large struthioid closely allied to the emeu is one more instance of the originally wide distribution of the struthioid birds; and it not improbably indicates that the home of the group of which the cassowaries, emeus, and moas are diverging branches was originally somewhere in the neighbourhood of the Indian region; from whence a migration took place during some part of the tertiary period towards the south-east, where the group, in regions more or less completely free from the larger mammals, subsequently attained its greatest development.

Genus, non. det.

Phalangeal.—In plate XIV., fig. 8, there is represented, from the anterior aspect, the second phalangeal of the middle (third) digit of the foot of a tridactyle struthioid

from the Siwalik Hills; of which other views are given in the plate accompanying Mr. Davies' memoir. This specimen is but slightly larger than the corresponding bone of one of the species of *Casuarius*, and would, therefore, seem too small to have belonged to the last species. According to Mr. Davies¹ this bone differs from *Dromæus* and *Casuarius* so markedly that it seems to be generically distinct from both, although nearer the latter than the former. It cannot apparently be identified with any other described genus.

Additional specimens are required before the affinities of this bone can be fully determined, but it apparently indicates a third form of Siwalik struthioid.

¹ *Op. cit.*, pp. 22-3. Dimensions and a description are given in this notice.

PLATE XIV.

AVES.

- Fig. 1 *LEPTOPTILUS FALCONERI* (M. Edws.). Distal extremity of the left humerus, viewed from the palmar aspect; from the Siwalik Hills: British Museum (No. 48,446).
- „ 2, 2a, 2b. *DROMÆUS* (?) *SIVALENSIS*, Lyd. The first phalangeal of the outer (fourth) digit of the right foot; from the Siwaliks of the Punjab: Indian Museum (No. E. 1). 2 from the anterior, 2a from the posterior, 2b from the proximal aspect.
- „ 3, 3a, 3b *MERGUS* (?) sp. Early cervical vertebra, from the Siwaliks of the Punjab: Indian Museum. 3 from the haemal, 3a from the anterior, 3b from the neural aspect.
- „ 4, 4a, 4b. *DROMÆUS* (?) *SIVALENSIS*, Lyd. The second phalangeal of the outer (fourth) digit of the left foot, from the Siwaliks of the Punjab: Indian Museum (No. E. 3). 4 from the anterior, 4a from the proximal, 4b from the distal aspect.
- „ 5 *DROMÆUS* (?) *SIVALENSIS*, Lyd. The second phalangeal of the outer (fourth) digit of the left foot; from the Siwaliks of the Punjab: Indian Museum (No. E. 4). From the anterior aspect.
- „ 6 *DROMÆUS* (?) *SIVALENSIS*, Lyd. The first phalangeal of the outer (fourth) digit of the left foot; from the Siwaliks of the Punjab: Indian Museum (No. E. 2). From the anterior aspect.
- „ 7, 7a, 7b, 7c, 7d *CICONIIFORM*, *gen. non. det.* Fourth cervical vertebra, from the Siwaliks of the Punjab: Indian Museum (No. E. 8). 7 from the right lateral, 7a from the anterior, 7b from the posterior, 7c from the neural, 7d from the haemal aspect.
- „ 8 *STRUTHIIFORM*, *gen. non. det.* Second phalangeal of the middle (third) digit of the foot; from the Siwalik Hills: British Museum (No. 39,783). From the anterior aspect.
- „ 9, 9a, 9b *LEPTOPTILUS FALCONERI* (M. Edws.). Distal extremity of the right tibia; from the Siwaliks of the Punjab: Indian Museum (No. E. 10). 9 from the anterior, 9a from the posterior, 9b from the distal aspect.
- „ 10, 10a *PHALACROCORAX* (?) sp. Proximal half of the metatarsus; from the Siwalik Hills: British Museum (No. 39,742). 10 from the anterior, 10a from the posterior aspect.
- „ 11, 11a. *PELECANUS CAUTLEYI*, DAVIES. Distal extremity of the left ulna, from the Siwalik Hills: British Museum (No. 39,740). 11 from the external, 11a from the palmar aspect.
- „ 12 *LEPTOPTILUS FALCONERI* (M. Edws.) First phalangeal of the outer (fourth) digit of the right foot; from the Siwaliks of the Punjab: Indian Museum (No. E. 9). From the anterior aspect.
- „ 13. *Gen. non. det.* First phalangeal of the median (third) digit of the foot; from the Siwaliks of the Punjab: Indian Museum. From the anterior aspect.
- „ 14. *LEPTOPTILUS FALCONERI* (M. Edws.). Distal extremity of the left metatarsus; Siwalik Hills: British Museum (No. 39,786). From the anterior aspect.

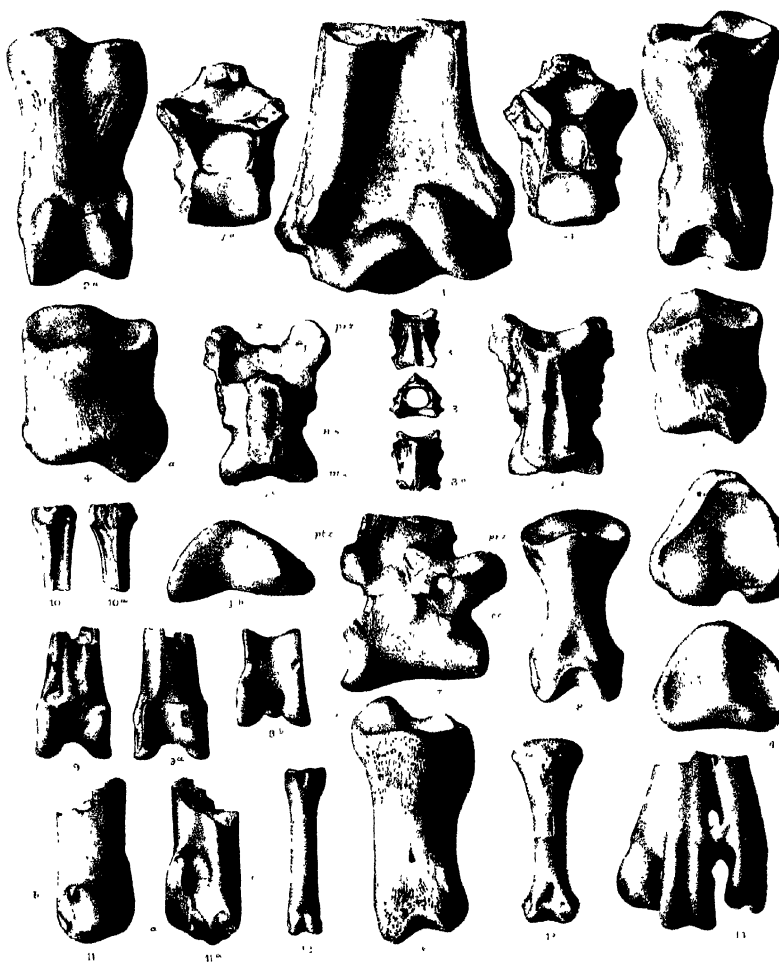


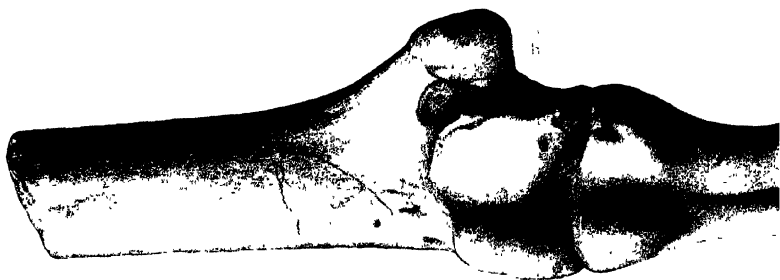
PLATE XV.

AVES.

STRUTHIO ASIATICUS, A. Milne-Edwards.

- Fig 1, 1a The greater portion of the shaft of the right tibia and fibula; from the Siwalik Hills. Indian Museum (No. E. 7). 1 from the anterior, 1a from the posterior aspect.
- " 2, 2a. The distal portion of the right tibia, from the Siwalik Hills: British Museum (No. 39,732). 2 from the anterior, 2a from the posterior aspect.
- " 3. The distal portion of the right metatarsus, and the proximal portion of the first phalangeal of the third digit; from the Siwalik Hills: British Museum (No. 43,106). From the posterior aspect.

Figs. 1, 1a, 2, 2a, $\frac{1}{2}$ nat. size; fig. 3, natural size.



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